# National Transportation Safety Board

## Marine Accident Brief

### Fire Aboard Containership *Gunde Maersk*

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| **Accident no.** | DCA16FM009 |
| **Vessel name** | *Gunde Maersk* |
| **Accident type** | Fire |
| **Location** | Seattle, Washington |
| **Date** | December 8, 2015 |
| **Time** | 0509 Pacific standard time (coordinated universal time − 8 hours) |
| **Injuries** | None |
| **Property damage** | $380,000 |
| **Environmental damage** | None |
| **Weather** | Light rain, visibility 4 miles,[1] winds south-southeast at 8.1 mph, air temperature 52°F |
| **Waterway information** | Elliott Bay, also known as the Port of Seattle, is a deep water port within Puget Sound |

On December 8, 2015, at 0509 local time, a fire broke out in auxiliary engine room no. 1 on board the containership *Gunde Maersk* shortly after the vessel departed Terminal 46 in Seattle, Washington. The fire was quickly extinguished by the vessel's high pressure water mist system. As a result of the fire damage, the vessel lost propulsion and required tugboats to return to its berth. There was no environmental damage and none of the 23 crewmembers were injured. Damage was estimated at $380,000.


**The 9,700 TEU *Gunde Maersk* at berth 37 in Seattle, Washington, on December 10, 2015.[2]**

[1] All miles in this report are nautical miles (1.15 statute miles).

[2] *TEU*, or *Twenty-foot Equivalent Unit*, is the unit of cargo capacity for a containership. The term is taken from the standard length of a shorter shipping container, with the two most common container lengths being 20 and 40 feet.



Note: This report was reissued on April 3, 2017, with corrections to page 6.

## Background

On January 1, 2015, the North American Emission Control Area (ECA), which extends 200 miles out from the coastlines of the United States and Canada, was established under the International Convention for the Prevention of Pollution from Ships (MARPOL). The ECA requires all vessels to use fuel with 0.10-percent or less sulfur content for the entire time they are operating in the ECA, including inbound and outbound transits. As a result, vessels using higher sulfur content fuels must change to ultra low sulfur fuel oil prior to entering the ECA.[3]

On November 25, 2015, the *Gunde Maersk* switched from using heavy fuel oil to ultra low sulfur marine gas oil as it entered the North American ECA en route to Long Beach, California. Soon after the switch, the vessel's auxiliary engines—three 4,667-horsepower eight-cylinder Caterpillar engines, each directly coupled to a ship's electrical generator—began leaking fuel. Due to various differences in the properties of fuels, leaks and other mechanical impacts are common after a fuel changeover. Coast Guard Safety Alert 2-15 notes "several reported incidents involving substantial machinery space fuel leakages while vessels were switching fuel."

To repair the leaks on the auxiliary engines, the crew of the *Gunde Maersk* replaced O-rings throughout each engine's fuel system, with the third engineer and a motorman assigned to complete the work. The third engineer was fully qualified and had previously performed the task. He and the motorman conducted a safety job analysis, and the company's permit to work process was carried out prior to starting the job.[4] The crewmembers replaced the O-rings in the fuel supply piping rail for auxiliary engine no. 3 on November 26, auxiliary engine no. 2 on December 1, and auxiliary engine no. 1 on December 2. Each fitting requiring a replacement O-ring was secured in place with four bolts. After completing the work, the crew tested the installation for 10 minutes, running the engine at idle speed. Fuel flow at idle speed, however, was less than normal operating flow.

## Accident Events

The *Gunde Maersk* departed Long Beach on December 1 and arrived at Seattle's Terminal 46 berth 37 on December 7. At 0502 on December 8, the containership got under way from its berth en route to Busan, South Korea. A few minutes later, at 0509, fire broke out on auxiliary engine no. 1. The engine had run a total of 3 hours since the installation of the new O-rings.

A fire alarm was triggered by a detector located above the engine and the engine automatically shut down. When the engine stopped, one of the remaining auxiliary engines that was running at the same time took the electrical load. The ship did not lose electrical power.

An installed high pressure water mist system activated automatically and extinguished the fire. Ventilation fans for the space shut down when their controllers burned and the fire dampers

[3] US Coast Guard, *Ultra Low Sulfur Fuel Oil & Compliance with MARPOL Requirements*, Safety Alert 2-15, Washington, DC, March 3, 2015.

[4] A *permit to work process* is a system used to manage high risk activities. It enables an assessment of risks to be made and specifies control measures to be put in place in order to minimise the risk (adapted from Oxford Brookes University, *Code of practice for permits to work*, www.brookes.ac.uk/services/hr/health_safety/permit_to_work/procedure.html, accessed November 8, 2016.

for each fan closed. Doors to the space had been closed before the fire started, which prevented a further supply of air reaching the affected space.

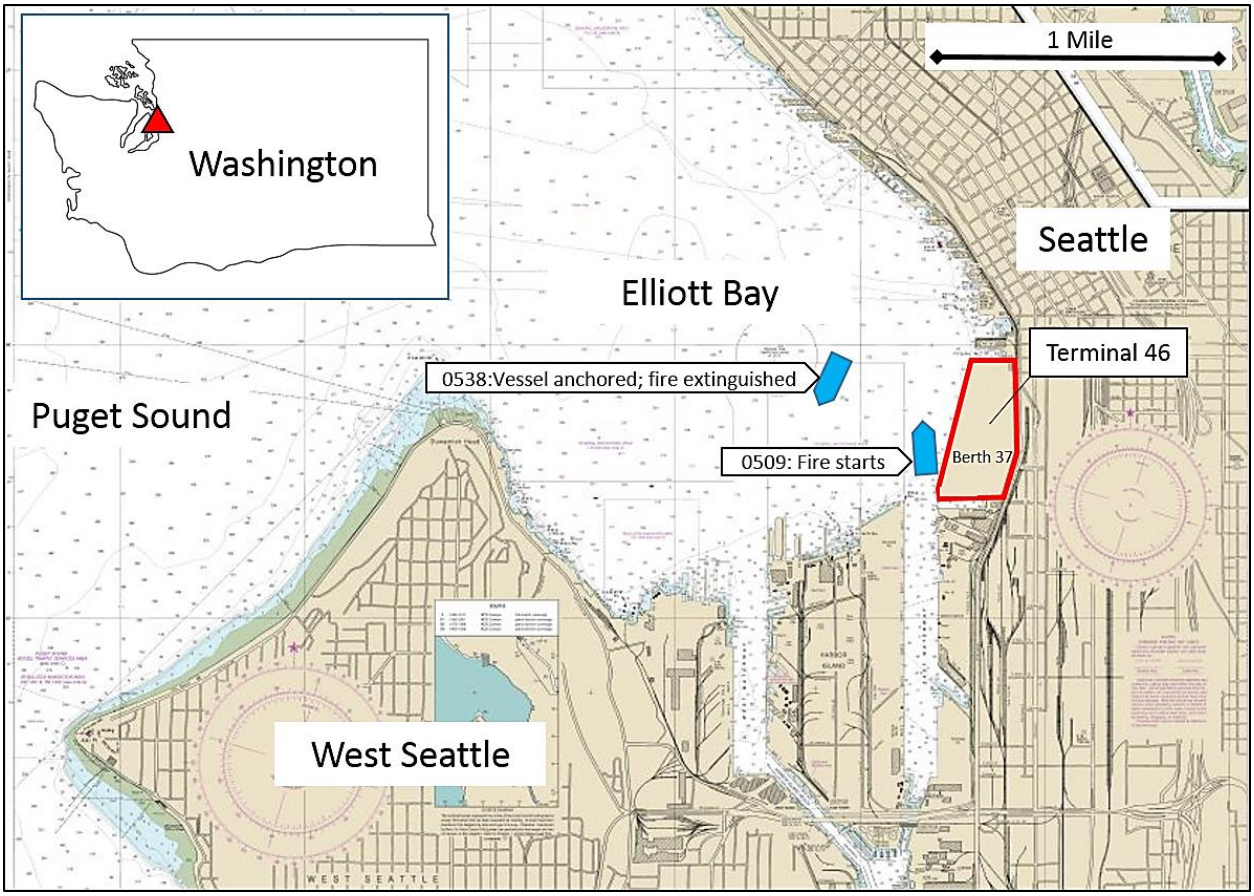



**Chart showing the location of *Gunde Maersk* at the start of the fire and when the vessel anchored (vessel, shown in blue, not to scale). Inset shows the State of Washington with the accident site indicated by a red triangle. (Background NOAA Chart 18450)**

The general alarm activated automatically almost immediately after the fire began. Two firefighting teams were assembled to fight the fire. One team entered the space at 0523, confirmed the fire was out, and reported that the compartment was filled with black smoke. That fire team left the space at 0528. The crew monitored bulkhead and internal temperatures until the temperature inside the space cooled to 196 degrees F, at which time they ventilated the space.

The loss of auxiliary engine no. 1 and its associated generator introduced an error in the high voltage electrical system and integrated automation system (IAS), causing a loss of control of the main propulsion engine fuel pumps. As a result, the vessel's IAS shut down the main propulsion engine. The crewmembers were unsuccessful in their attempt to manually restart the engine, so at 0538 the vessel anchored about a quarter mile from its original berth. Four tugboats were employed to return the vessel to the pier.

**Fire damage to auxiliary engine no. 1. Left photo shows inboard side, looking forward; right photo shows the outboard side, looking aft. (Photos courtesy of Lavaretus Risk Engineering)**

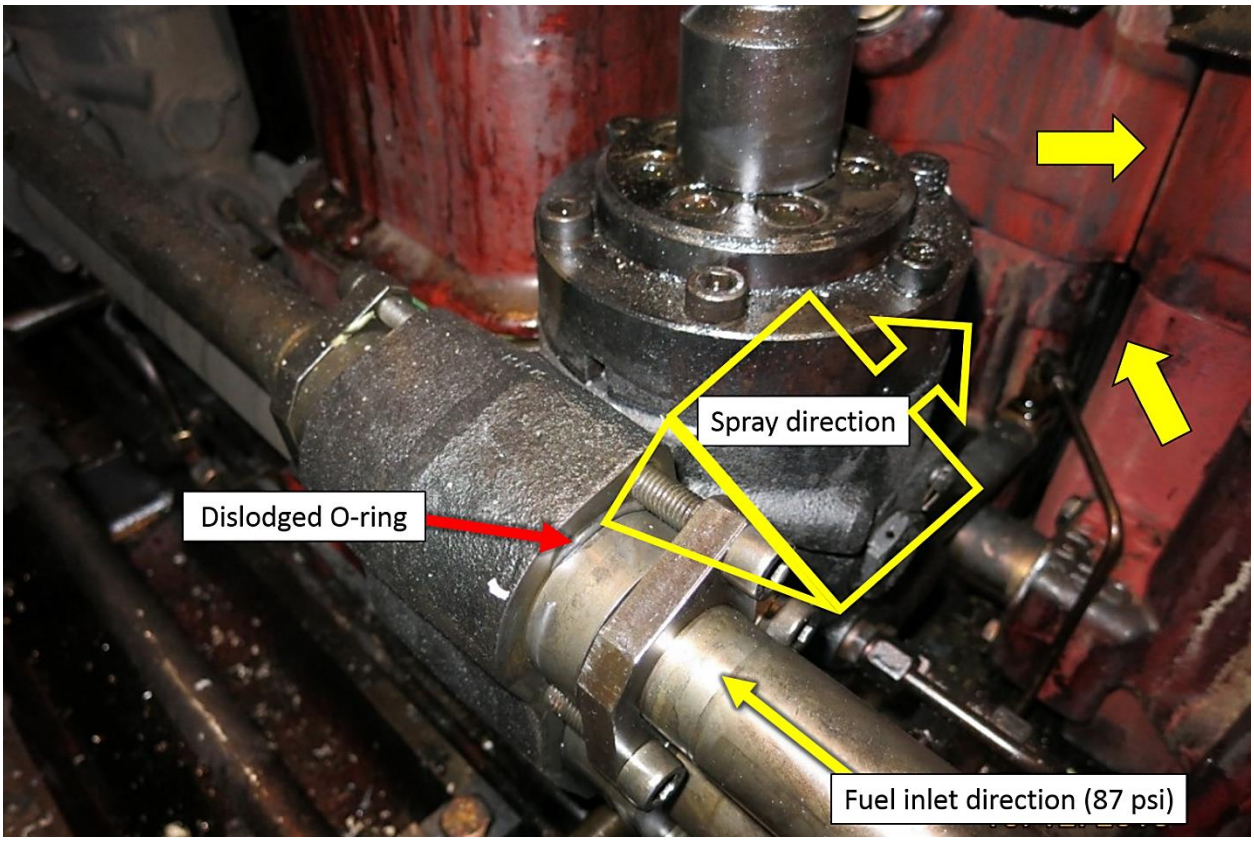
## Accident Analysis

Investigators determined that the fire was caused by fuel leaking from a dislodged 1.5-inch-diameter O-ring in the fuel supply line to the no. 3 cylinder fuel injection pump, located near the top of auxiliary engine no. 1. Fuel in the supply line, pressurized to 87 pounds per square inch (psi), sprayed out around the O-ring. Some of the spray struck shields designed to prevent atomized fuel from spraying the engine room, while the remainder of the spray entered the exhaust side of the engine through the space between the cylinder heads. The fuel that struck the spray shields dripped into a fuel drain channel that ran the length of the engine under the fuel supply pipe. The fuel then drained into the 5-liter-capacity overflow tank until the tank was filled, sounding the tank overflow alarm.

The source of ignition was most likely fuel spraying and flowing onto the exhaust side of the engine between the cylinder covers. The exact time the leak began could not be determined, but it continued for a long-enough period to fill the overflow tank before the fire started. The fuel overflow tank alarm activated 13 seconds before the fire alarm sounded.

The exact point of ignition also could not be determined. However, the exhaust piping, which is estimated to have been between 575 and 850 degrees F at the time of the fire, was the most likely location.

Investigators found that the bolts and fitting where the leak occurred were in good condition. The NTSB performed a microscopic examination of the O-ring, and no damage or imperfections were found. It is likely that the leak occurred because the fitting was not tightened with a torque wrench as prescribed in the manufacturer's written procedures.




**Location of fuel leak on Auxiliary Engine No. 1 fuel injection pump #3 (Photo courtesy of Lavaretus Risk Engineering)**

Additionally, a root cause report issued by the operating company after the accident noted that procedures to replace O-rings on auxiliary engines did not include a post-repair testing procedure. Had the fuel system been tested using a standard procedure under normal operating conditions, it is possible that the leak would have been found before the fire started.

## Probable Cause

The National Transportation Safety Board determines that the probable cause of the fire aboard the containership *Gunde Maersk* was an improperly installed fitting on a fuel line supplying a fuel injector pump for auxiliary engine no. 1.

### Adherence to Standard Maintenance and Repair Procedures

The NTSB continues to see fires and other accidents caused by failure to adhere to standardized procedures during the maintenance, repair, and testing of equipment. Standardized procedures, which include the use of proper tools, ensure system integrity and the safe operation of equipment within designed specifications. This simple guidance bears repeating, because the consequences of failure—$380,000 in damage to the *Gunde Maersk* alone—can be significant.

### Operational Testing Procedures

Post-repair and maintenance operational testing of equipment should be standardized and, where possible, conducted at normal operational pressures and loads to verify the quality and reliability of the maintenance conducted.

## Vessel Particulars

| Vessel | *Gunde Maersk* |
|---|---|
| **Owner/operator** | Maersk Line A/S / Maersk Line |
| **Port of registry** | Dragoer, Denmark |
| **Flag** | Denmark |
| **Type** | Containership |
| **Year built** | 2008 |
| **Official number (US)** | NA |
| **IMO number** | 9359014 |
| **Construction** | Steel |
| **Length** | 1,204 ft (366.89 m) |
| **Draft** | 49.2 ft (15 m) |
| **Beam/width** | 141 ft (42.95 m) |
| **Gross and/or ITC tonnage** | 98,268 gross tons; 98,268 ITC tons |
| **Engine power; manufacturer** | 84,015 hp (61,776 kW); Doosan-Wartsila-Sulzer |
| **Persons on board** | 24 |

**NTSB investigators worked closely with our counterparts from Coast Guard Sector Puget Sound throughout this investigation.**

For more details about this accident, visit www.ntsb.gov and search for NTSB accident ID DCA16FM009.

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